are armed with spines; others (Ononis) are covered with sand; still others have a bitter taste (Salix, Galium verum), or are acrid (Euphorbia Paralias); many contain essential oils displeasing to herbivora, finally, the fleshy plants, the most exposed of all, are strongly protected by their saline flavor (Cakile, Salsola, Salicornia, Aster, Statice).

4. *Origin of the littoral flora.* The paucity of species of the littoral flora is accounted for by the diversity of destructive causes at work, which also explains the great number of individuals in the case of those plants which are well adapted to the prevalent conditions.

In order to throw light upon this subject the author has sown and transplanted to Brussels a large number of the plants of the dunes and schorres. This will be followed by a study of whatever modifications take place because of this change of environment. The inverse experiment has also been tried of transplanting 400 species of perennials cultivated in the Botanic Garden at Brussels, to various places along the coast —GILBERT H. HICKS.

## Nature and life history of starch grains.[1]

The recently published work of Meyer forms the most important contribution to the knowledge of starch grains which has appeared since Schimper's researches in 1880. According to Meyer, starch grains are true sphere crystals in every way analogous to the sphere crystals of inulin, and are composed of two forms of amylose and a trace of amylodextrin. In an anomalous form which colors reddish-brown with iodine, the proportion of amylodextrin is very large. This red starch is characteristic of a large number of saprophytes but has been found in less than a score of the higher green plants. In opposition to the theory of Tammann, Meyer finds that the action of diastase on starch is a purely katalytic process and in every way analagous to the katalytic action of acids except that it is more easily influenced by external conditions, such as heat, etc.

Under diastatic action, amylose takes up water and splits into two molecules of amylodextrin, which is transformed into isomaltose and dextrin. Both of these substances pass

[1] Arthur Meyer. Untersuchungen über die Stärkekörner. Wesen und Lebensgeschichte der Stärkekörner der höheren Pflanzen. pp. xvi+318. pl. 9, figs. 99. Gustav Fischer. Jena. 1895.

into maltose. The validity of the observations upon which is based Nägeli's hypothesis as to the growth and structure of starch grains is denied in toto. The grains have their origin and growth entirely within chromatophores where they are held as long as the cell is living. Growth consists of the superposition of new layers of material on those previously formed. The layers or coats are due to the periodic activity of the chromatophore. The contour of the grains is due entirely to the pressure exerted on the chromatophore by the cytoplasm, and the size depends upon the biologic relations of the plant. Thus in rapidly germinating seeds or in other structures where rapid solution of reserve material is desirable, the grains are small, and easily fissured. The granula of the chloroplasts are regarded as the organs of synthesis of the carbohydrates, and the stroma as the organ of formation of starch material and diastase. In the consideration of the morphology of the chromatophore the author is led to conclusions in harmony with Berthold's theory of the emulsion structure of protoplasm. In a series of monographs which form an appendix to the chief thesis, he describes the results of his researches on the seasonal periodicity and other biologic relations of the starch grains of Dieffenbachia seguina, Pellionia daveauana, Hyacinthus orientalis, Cyrtodeira cupreata, Adoxa moschatellina, and Hordeum distichum. The book contains all of the author's work upon starch, much of which has been previously published. It is well illustrated and logically arranged. The great number of macro- and micro-chemical reactions given makes the work invaluable in the laboratory. With this work at hand the archaic views as to the composition, structure, and growth of starch grains which find place in the best botanical as well as chemical text books will no longer be excusable.—D. T. MAC DOUGAL.

### Arctic and Alpine plants.[1]

The present paper by Bonnier points out the difference in structural development of some arctic plants as compared with the same species collected in the Alps and Pyrenees. The arctic plants were collected by Charles Rabot, who visited Jan Mayen and Spitzbergen in the summer of 1892. We must note, however, that since these plants were col-

[1]Gaston Bonnier: Les plantes arctiques comparées aux mêmes espèces des Alpes et des Pyrénées. Revue gén. de Botanique **6**: 505–527. *pl. 4.* 1894.